

Is intentional extinction ever the right thing?

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Credit: PLOS Blogs

Consider this. It may be possible to eliminate some of the world's deadliest diseases, save [2.7 million human lives per year](#), and save millions more from getting sick...all that is needed is to cause the extinction of a couple of species. Should we?

What was your reaction to that sentence? As an [ecologist](#) does the word extinction immediately send up red flags? What about all of those lives that could be saved? Could the loss of a species ever be outweighed by the human lives it saves? Is it legitimate to weigh the loss of a species on that basis? What if that species was small and decidedly not cuddly, does that matter? Given that tools are now available to eradicate a species using its own [genetic code](#) it's time to ask those questions.

Scientists increasingly agree that the latest advances in gene editing make it possible to eradicate [mosquitos](#) using a genetic trick called a [gene drive](#). Exploiting the idea of the "selfish gene," alleles that are inherited at greater than 50% probability, it is possible to create an allele detrimental to the survival of an organism [that nevertheless spreads to fixation](#) in the population, causing it to crash and ultimately to go extinct. This idea has been bandied about for years, but workable gene drives haven't really been possible until the advent of the CRISPR [gene editing](#)

technology and targeted RNA endonuclease proteins such as Cas9. Gene drives have already been created for one species of mosquito and tested successfully in the lab. [PLOS Synbio Community](#) has an excellent article on [how this technique works](#).

As ecologists though, the technique perhaps isn't as important as the ethical questions the use of a gene drive brings up. Numerous news outlets have reported on the idea of eradicating mosquitos worldwide as the Zika virus has spread into a global epidemic and news of the disease has been magnified in the spotlight of the Summer Olympics in Rio.

Headlines like, "[Let's Kill All the Mosquitoes: Now is the time to wipe these disease carrying critters off the face of the earth](#)," and "[Should we wipe mosquitoes off the face of the Earth?](#)" are two of many articles with a similar theme that have come out recently.

A surprisingly pro-eradication [news feature in Nature](#) concludes, "Eradicating any organism would have serious consequences for ecosystems—wouldn't it? Not when it comes to mosquitoes, finds Janet Fang." The article argues that the species that are highly dependent on mosquitos are few, the balance of ecosystem services doesn't favor keeping mosquitos around, and that ecosystems would likely quickly fill the niche currently taken by mosquitos. The article ends with a quote from entomologist Joe Conlon from the American Mosquito Control Association,



Mosquitos are responsible for millions of human deaths per year through their role as a disease vector. Credit: PLOS Blogs

"They don't occupy an unassailable niche in the environment, If we eradicated them tomorrow, the ecosystems where they are active will hiccup and then get on with life. Something better or worse would take over."

Ecologists and conservation biologists often are the scientists dealing directly with the unwanted loss of global biodiversity, with warnings becoming more frequent that [the Anthropocene will be marked by a new mass extinction event](#). The predominant understanding is that ecosystem resilience is harmed by species loss. In this context, is it safe to make the assumption that the intentional loss of a species is likely to have negligible impacts?

Mosquitos are pollinators of numerous species, so their niche extends beyond simply being an annoying, painful disease vector and food for fish and bats. Can their role as pollinators be taken over quickly and easily by other species? Given the complicated interconnections within ecosystems can this role be glossed over as easily as "their pollination isn't crucial for crops on which humans depend," as the article states?

Can the indirect effects of losing a species like mosquitos be understood to the degree that we can convince ourselves that this loss wouldn't come back to, well, bite us?

The history of human efforts to engineer ecosystems in our favor are littered with plenty of examples of species eradications or introductions which seemed innocuous, limited, and positive at the time but later turned out to have unintended consequences. In my own field the intentional introduction of [common carp](#) and more recently [Asian carp](#) have been cited as problematic for native ecosystems. The same is true of trout introductions into mountain lakes and the [unintended decline in native amphibian populations](#). Outside of the realm of fish the ecological changes seen with the re-introduction of wolves to Yellowstone provides an example (paywall) of the unintended, far-reaching trophic effects of intentional extirpation of a species.

There are no current plans to begin trials of a gene drive eradication effort in mosquitos, and there are non-eradication alternatives even within the gene drive concept. However, the technology exists, and with millions of human lives at risk, eventually pressure will grow to use it. Now is the time for ecologists, ethicists and philosophers to be asking the questions that need to be answered before this technology is used.

For ecologists who have come of age in the shadow of the debate surrounding the Anthropocene extinction event the idea of intentionally sending a [species](#) to extinction brings up all kinds of moral and ethical questions...not to mention the possibility of several related avenues of research. Perhaps now is the time to start a deeper conversation about these issues.

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